INSTRUCTIONS TO STUDENTS

ACCEPTANCE: This is to advise you that those individuals in Enclosure 1 have been accepted for participation in the training course (H-201) AHealth Phd

OBJECTIVE

This math review handout was recommended by students in previous Health Physics Technology courses. They noted on Course Evaluation Forms that their math skills were "rusty" having been out of school for a while and not having had the opportunity to use them.

The purpose of this Math Review

$$
\begin{array}{l}
\quad (a + b) \\
\times\ (c + d) \\
\hline
ad\ +
\end{array}
$$

Let’s graph these two equations

$$y = 2x+1$$

System of Equations

The final method is Linear Combination

In linear combination,

LAWS OF EXPONENTS

The following expressions cannot be simplified any further:

$x^a y^a$ & x^a/y^a

$$x^{1/2} = \sqrt{x}$$

For

DIMENSIONAL ANALYSIS

We start out with units of oz/yd^2

GEOMETRY

Rectangle = Length x Width

L

Wx

Area of Generic Triangle

Area of rectangle = B x H

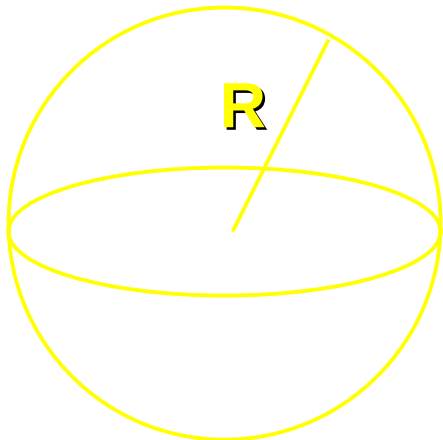
SURFACE AREA

Sphere = 4 π RSphere = 4 04 TD-0.0028 Tj1 1 0 sS

VOLUME

Box = L X W X H

Sphere = $\frac{4}{3} \pi R^3$



PROBLEMS (calculate the following)

1. area of a circle with a 4 cm diameter?

2. surface area of a hemisphere with a 2.4 meters radius

3. volume of a sphere with a 78 cm d

4. width is 3 cm and depth is 12 cm? length is 12 cm?

5. surface area of a box whose lengt

Degrees	Radians		
0	0π	=	0.0000

The sine of an angle is just a number with no dimensions.

If you know the number and want to find the angle

erse

er, you can use the

sine or

PROBLEMS (calculate the following)

1. arctan (0.666) in degrees

2. inverse cosine (0.17) in radians

LOGARITHMS

Common Logarithm

Base 10 ($\log_{10}$)

or

Natural Logarithm

Base e ($\ln_e$)

(e = 2.7183)

The answer "Y" to "$\log_{10} X = Y$" can be thought of as:

"How many times must 10 be multiplied by itself to yield X ?"

or in a slightly different way

"What power must 10 be raised to (i.e., 10^Y) to get X ?"

Y is the answer !

Example: $\log_{10}(100) = 2$ because $10 \times 10 = 10^2 = 100$

(X = 100 Y = 2)

Similarly

“ e

Number
0

In

On your calculator you should have two keys:

one labeled log which is base 10 and
one labeled ln which is base e

Each key may be associated with an inverse
which might require you to press a 2ndF key

The inverse of log is a power of 10: 10^x
The inverse of ln is an exponential: e^x

$\log_{10}A = B$ $10^B = A$

$\ln_e$

PROBLEMS (Calculate the following)

1. the common logarithm of 88

2. the natural logarithm of 123

3. the ratio of the natural logarithm of 452

63 anipulating Powe+263

INTERPOLATION

NOTE: Some of the following slides list pages in the Health Physics Technology Reference Manual for looking up Table values. The values are given to you. However, if you wish to look them up yourself and you do not have acce ss to this Reference Manual you can use any available Health Physics source such as the Ra diological Health Handbook.

The simplest form of interpolation is the “guesstimate”.

Let’s say you have a set of numbers like these:

speed (mph)	stopping distance (feet)
10	10
20	40
30	70
40	95
50	120
60	150

e e r a a o o y y f f l at is th
g n i l l e v a r travelling 45 mph, you ca
you can “eyeball” the ans

$$\frac{7-y}{3-2.5} = 2$$

$$\frac{7-y}{0.5} = 2$$

$$7-y = 1$$

$$7-1 = 6 = y$$

So when x = 2.5, then y = 6

Sample Problem

Determine $_{en}/\mu$ for 7 MeV photons traversing compact bone

Looking up some adjacent values from the Table on page MISC-26 yields

MeV	$_{en}/\mu$
6	0.0178
7	?
8	0.0165178

Using linear interpolation wt2wet:

One Last Problem

Determine the buildup factor for ^{60}

Unfortunately, we have a double interpolation.

We have to interpolate between

$$\frac{2.135 - 1.975}{2 - 1} = \frac{2.135 - y_2 - 1.25}{1}$$

$$\frac{2.135 - y_0}{1}$$

Material	MeV	μx*					
		1	[redacted]	7	10	15	20
[redacted]							

RULES:

1. You can multiply both sides of an equation by the same value

2. You can divide both sides of an equation by the same value

3. You can add the same value to both sides of an equation

4. You can subtract the same value from both sides of an equation

5. You can multiply any side of an equation by 1 or any ratio which equals 1 (e.g5 a / a)

6. You can "flip" both sides of an equation (i.e. reverse numerator and denominator) provided there is only one denominator on each side, e.g5 (1/a = 1/b→

$$A = \frac{B}{C} + \frac{D}{E}$$

$$\frac{\quad}{C} = \qquad + \frac{E}{B}$$

$$A = B_x$$

Extracting Information from Tables

To solve exam problems you will

To solve exam problems yo

numbers from reference ta

Example

Solve ax + b = y for "x"

$$6x + 3 = 28.2$$

One equation, one variable equals one solution

Solve for x:

$$6x = 28.2 - 3 = 25.2$$

$$\boxed{x = 25\ s/6 = 4.2}$$

$$10x + 5 = y$$

One equation, two variables equals many solutions

0	5
1	15
2	25

3(scn- m scn-0.04 0.04

Solve for x:

$$x = (y - 5)/10 = 0.1\ y$$

SAMPLE

(test your knowledge)

$$3x + 4y = 18$$
$$5x - 3y = 1$$

$$5 \times (3x + 4y) = (18) \times 5$$
$$3 \times (5x - 3y) = (1) \times 3$$

$$15x + 20y = 90$$
$$-15x - 9y = 3$$

$$29y = 87$$

$$y = 87/29 = 3$$

Now if we plug y = 3 into either of the two original equation, we can solve for x which equals 2

SAMPLE

$$x^2 + 8x = -7$$

$a = 1$
$b = 8$
$c = 7$

PROBLEMS

PROBLEMS (Calculate the following)

1. the common logarithm of 88

2. the natural logarithm of 1232.

$$A = \frac{B}{C} + \frac{D}{E}$$

$$\frac{AE - D}{E} = \frac{B}{C}$$

To isolate "C" we can multiply both sides by "C" and multiply both sides by "E" and then divide both sides by (AE - D).

This produces the same effect as flip

$$A = B \times e^{\frac{C \times D}{E}}$$

Sample problem of this type:

The equation for radioactive decay is

$$A = A_o \times e$$

$$A = B \times \ln \left[\frac{C}{D} \right]$$

But an exponential and a natural logarithm are inverses so they cancel leaving the variables.

$$e^{A/B} =$$

$$A = B^C$$

To isolate "C" we need to remove it from the power position and get it back on a normal level. We can do

$$A = B \times \text{sine } C$$

To isolate "C" we'll need to employ the inverse of the

See page 94

$$A = (B + C)\ x$$

Now we merely subtract “B” from each side

$$\frac{A}{(D + E)}\ s\ B = C$$

$$A = B \times C^{n}$$

The isolate "C" we need to get rid of is the power "n".

$$n = \frac{\log(A/B)}{\log(C)} = \frac{\log 1.0}{\log -0.04} = 0.0$$

A

BB =

Instead of using logarithms and

To convert from “A” to “B” find the “A” column along the top row. Drop down to the box containing the number “1". Move across to the “B” column. Multiply your “A